REMARKS

The Examiner objected to the drawings as failing to comply with 37 CFR 1.84(p)(4) because the reference characters "20" and "54" were used to designate the same layer in Figure 2-6. Also reference character "20" used in Fig. 2-10 and Fig. 2-11 and reference character "20, 54" used in Fig. 2-9 were both used to designate the same layer. The Examiner also objected to the drawings as failing to comply with 37 CFR 1.84(p)(5).

In conformance with the Examiner's recommendation, Applicants have changed reference character "20" in Fig. 2-6 (Fig. 2F) to "20, 54" and the reference character "54" has been removed. Further, reference characters "20" in Fig 2-10 (Fig. 2J) and Fig. 2-11 (Fig 2K) have been changed to "20, 54." Both clean and marked-up Replacement Sheets are submitted herewith.

The Examiner also objected to the drawings as failing to comply with 37 CFR 1.84(p)(5) because they include the reference character "2…5" not mentioned in the description. The term "2…5" was not a reference character but was merely a shorthand way of stating that steps 2, 3, 4, and 5 from Figure 1 are repeated. Applicants have amended the drawings to explicitly show each step with newly numbered Figures 1A through 1L and Figures 2A through 2K.

The Examiner objected to the disclosure of the specification because it did not include headings or subheadings to denote sections as noted in 37 CFR 1.77(b). In response, the Applicants attach herewith a substitute specification adding the section headings, correcting errors in the citation of the references in Annex 1, and replacing the previous drawing designations Fig. 1-1, 1-2, etc. with the updated drawing notation Fig. 1A, 1-B, etc. Applicants present the substitute specification in both marked-up and clean forms in conformance with 37 CFR §1.121 and 37 CFR §1.125. No new matter has been added.

The Examiner noted that the information disclosure statement filed April 4, 2007 failed to comply with 37 CFR 1.98(a)(3) because it did not include a concise explanation of the relevance of each foreign patent an non-patent literature document that is not in the English language. Specifically, the Examiner noted that non-patent literature document Yi, H. et al. does not include an English Abstract or a translation explaining its relevance. In response, Applicants refer the Examiner to both the information disclosure statement filed herewith as well as renumbered paragraph [0017] of the substitute specification, stating that Yi does not teach stacking or etching of the barrier layers. Since Yi does not teach stacking or etching, Applicants do not believe that the Yi reference is particularly pertinent. It has been included here to resolve in Applicants' favor any question whether Applicants' duty of disclosure has been satisfied.

The Examiner also noted that foreign patent document KR0044158 does not have an English abstract. In response, Applicants refer the Examiner to the information disclosure statement and associated English abstract filed herewith.

The Examiner objected to Claims 18-20 and 29 as having no antecedent basis. Applicants have amended Claim 18 per the Examiner's recommendation.

The Examiner rejected Claims 1, 2, 7-9, 11, 15, and 21 under 35 U.S.C. 102(b) as being anticipated by International Patent Application Publication WO 03/085742 to Teng et al. (Teng). With regard to Claim 1, Applicants have amended Claim 1 to require that the succession of barrier layers are deposited in a *continuous* process sequence and that the step of etching the barrier layers occurs *after* the layers have been deposited. Support for the amendment may be found in the substitute specification in paragraph [0076], from Figures 1A-1L, and its discussion starting at paragraph [0028].

These sections of the specification and drawings clearly indicate that all the necessary

intermixing barrier layers have been completely deposited, shown in Figure 1A, and that the etching of these layers in different regions of the substrate occurs *after the deposition*, resulting in a more streamlined process. See Figures 1B to 1L. A similar discussion applies with respect to Figure 2.

In contrast, Teng teaches selectively depositing successive layers only to *specific* regions of the substrate surface (see page 9, lines 26-29 and page 11, lines 7-14). This means that the pattern definition process occurs between the deposition of each layer. Such a pattern definition process typically requires a photolithography pattern definition and an etch process (see page 12, lines 25 to 30 and Figures 6A, 6B of Teng) and necessarily involves cleaning and preparing the substrate prior to and subsequent to the deposition of each successive layer. This is because the intervening pattern definition steps, e.g. the application of photoresist, photoresist exposure and developing, and photoresist removal after the etching process, leave debris or residue that must be removed before the next layer is grown. As a result, the step of etching in Teng occurs *before* the deposition step is complete.

Additionally, since Teng teaches the use of the photomask and etch between each deposition step, it is apparent that Teng *cannot* provide for a continuous deposition process sequence as now required by amended Claim 1.

Figures 3A to 3C of Teng show that the first layer 8 is applied only in the region C, the second layer 9 is applied in the regions C and D, and the third layer 10 is applied in regions C, D, and E. Each layer has to be applied using at least one pattern definition process between the deposition of each successive layer. As described above, Teng requires the use of the intermediate mask deposition, removal, and cleaning steps to selectively apply the intermixing barrier layers. Therefore, the process disclosed by Teng cannot deposit a succession of barrier layers over the quantum well in a continuous process sequence, as is now required by amended Claim 1.

Claims 2, 7-9, 11, 15, and 21 are patentable at least for their dependency on Claim 1.

The Examiner rejected Claims 3, 12, 16, 18-20, 22-24, and 29 under 35 U.S.C. 103(a) as being obvious over Teng. Claims 3, 12, 16, 18-20, 22-24 and 29 are patentable at least for their dependency on Claim 1.

Further, with regard to Claim 18, Applicants disagree with the Examiner's interpretation of the language "planarizing the substrate." As used by the Applicants, the language "planarizing the substrate" means removing various layers from the substrate so that the substrate is more planar (see paragraph [0047] and Figures 1I-1L). As shown in Figures 1I through 1L and described in the Substitute Specification at paragraphs [0047]-[0052], the process of forming multiple quantum well intermixed regions is completed before the process of planarization starts. The described steps of planarization show how the horizontal profile of the substrate changes, becoming more flat as barrier layers are removed.

Conversely, the Examiner's interpretation results in the opposite. As shown in Figures 6A and 6B of Teng, the horizontal profile of the substrate becomes *less* flat as the barrier layer is removed. Moreover, the process of forming multiple quantum well intermixed regions has not been completed. Therefore, since Teng does not teach the step of planarizing the substrate as is required in Claim 18, Teng does not teach that the step of planarizing includes the steps of removing one or all of the intermixing barriers as required in Claims 19 and 20.

Claim 29 is patentable at least for its dependence on Claims 1 and 18. Further, the Examiner asserts that Teng teaches patterning different layers of materials in succession to achieve different band gaps. The Examiner also asserts that, based on results effective variables and routine experimentation, it would have been obvious to one of skill in the art to deposit an identical stack of layers below the intermixing barrier layers. Applicants respectfully disagree.

Applicants' specification teaches in paragraphs [0053]-[0055] that the replica stack layers serve an entirely different purpose than the barrier layers and do not function as the layers described in Teng. Specifically, Applicants state,

> The main barrier layers 20 to 25 are typically of the order of several hundred nanometres thick, or even up to 1 micron thick. The layer thickness of these barrier layers is determined by the requirements of the QWI process used, in that *the individual layer thicknesses must be sufficient to suppress migration of impurities to the quantum well to the extent necessary to achieve the correct bandgap* shifts. However, the replica stack layers 50 to 54 should consist only of thin etch-stop layers of the order of, typically, 20 to 30 nm thickness. As will become clear, the thickness of each of these layers should be sufficient to resist substantial over-etching periods of the adjacent upper layer, but *insufficiently thick to (a) cause planarity problems after the QWI process is completed, and (b) significantly reduce the local effectiveness of the QWI process*. (*Emphasis added.*)

Therefore, the Applicants teach using replica stack layers as an etch stop that are much thinner than the barrier layers and, therefore, do not affect the band gap of the substrate.

In contrast, Teng only teaches using barrier layers that have a thickness that is sufficient to affect the band gap and does not teach the use of a replica stack to act only as an etch stop. Consequently, the Applicants are using these thin layers in a manner that is completely different from that disclosed by Teng. It would not have been obvious from the teachings of Teng and with routine experimentation for one of skill in the art to use a replica stack because Teng does not teach using etch stop layers that have no significant effect on the band gap.

The Examiner rejected Claims 5, 6, 10, 25, and 28 under 35 U.S.C. 103(a) as being obvious over Teng in view of admitted prior art (APA) in U.S. Published Patent Application No. 2007/0246701 to Yanson et al. (Yanson) and rejected Claim 4 in view of Teng in view of U.S. Published Patent Application No. 2004/0038503 to Fu et al. (Fu).

The Examiner rejected Claim 13 under 35 U.S.C. 103(a) as being obvious over Teng in view of U.S. Patent Nos. 6,309,904 to Pommereau et al. (Pommereau) and 5,021,361 to Kinoshita et

al. (Kinoshita). Applicants have amended the form of Claim 13 to better conform to U.S. patent practice. The Examiner rejected Claim 14 in view of Teng in view of Pommereau and U.S. Patent No. 4,829,347 to Cheng et al. (Cheng). The Examiner rejected Claim 17 as being obvious over Teng in view of U.S. Patent Nos. 5,283,448 to Bayraktaroglu (Bayraktaroglu) and 5,527,732 to Kasahara (Kasahara). Applicants have amended the form of Claim 17 to better conform to U.S. patent practice. The Examiner rejected Claims 26 and 27 as being obvious over Teng in view of APA in Yanson and further in view of U.S. Patent No. 4,875,216 to Thornton et al. (Thornton). Claims 4-6, 10, 13, 14, 16, and 25-28 are patentable at least for their dependency on Claim 1.

Further with regard to Claim 4, Applicants have amended Claim 4 to require that the step of depositing the intermixing barrier layers occurs in the same epitaxial growth equipment and without removal of the substrate from the vacuum deposition environment. As described above, the patterning and deposition process described by Teng involves the steps of applying a photomask to the substrate, etching the substrate, cleaning the substrate, and further deposition. The additional processing steps cannot occur without removing the substrate from the deposition environment. Therefore, amended Claim 4 further defines over the process described by Teng.

Finally, Applicants have added new Claim 37. Support for the amendment may be found in Figure 1A which shows that the intermixing barrier layers are deposited across the entire surface of the substrate. Applicants' technique defines over the prior art because, as described above in the discussion of amended Claim 1, the etching of these layers in different regions of the substrate occurs *after* the deposition. See Figures 1B to 1L. Further, paragraph [0077] of the Substitute Specification shows that the Applicants' process ensures very good spatial uniformity of the layers and good control of the composition. Good control of these variables allows superior control of the etch rate and migration of the QWI initiating agent during the application/activation step.

In contrast, Teng teaches deposition of the barrier layers in *specific* regions of the substrate (see page 9, lines 26-29 and page 11, lines 7-14), requiring additional processing steps between the deposition of each layer. This causes the layers to be less uniform in thickness and composition and results in less control of migration of the initiating agent.

CONCLUSION

In summary, Applicants have amended Claim 1 to require that the succession of barrier layers is deposited in a continuous process sequence and that the step of etching the barrier layers occurs after the layers have been deposited. Further, Applicants are submitting new Claim 37 which requires that the intermixing barrier layers are deposited across the entire surface of the substrate. Applicants also submit replacement drawings in clean and marked up versions as well as marked-up and clean versions of the substitute specification in conformance with 37 CFR §1.121 and 37 CFR §1.125. Finally, Applicants are submitting an information disclosure statement. The Applicants believe the application is now in condition for allowance.

The requisite fee for a three month extension of time is being filed with this Amendment and Response. The Commissioner is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 503982 of Momkus McCluskey, LLC.

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